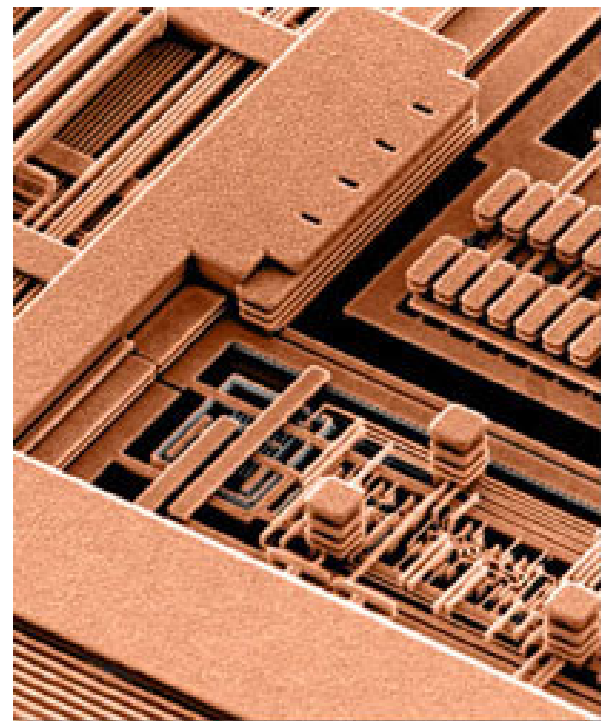


Overview Cu Run-5

Fulvia Pilat



Beam Experiments Meeting
BNL, September 16-17 2004





Overview Run-5 - outline

- ❑ Cu RHIC parameters
- ❑ Cu Run goals and modes
- ❑ Luminosity development
- ❑ Possible luminosity limitations
- ❑ (New) Timeline
- ❑ Dry-Runs
- ❑ Improvements Run-5
- ❑ Open issues
- ❑ Beam Experiments



Cu Run-5 RHIC Parameters

Parameter	Injection	Transition	Store	Unit
Q	29	29	29	
m	58.603772735	58.603772735	58.603772735	GeV/ c^2
W	10.302044	20.362485	99.069781	GeV/ N
cp	11.193678	21.272375	99.995673	GeV/ N
E	11.232263	21.292704	100.000000	GeV/ N
$B\rho$	81.1137824	154.147977	724.607889	Tm
β	0.99656480	0.99904526	0.99995673	
γ	12.07486366	22.8900	107.501611	
η	-0.00495	0.0	0.00182	
ϵ_H (95%)	$\leq 10\pi$	$\leq 10\pi$	$\leq 10\pi$	mm mrad
ϵ_V (95%)	$\leq 10\pi$	$\leq 10\pi$	$\leq 10\pi$	mm mrad
h	360	360	360	
hf	28.05396013	28.12378671	28.14944534	MHz
$2\pi R$	3833.845181	3833.845181	3833.845181	m

Maximum intensity

From injectors:

6×10^9 Cu ions/bunch

Goal at the end of 2 weeks injector set-up

3×10^9 Cu ions/bunch
(charge equivalent of $\sim 1 \times 10^9$ Au ions/bunch)

Parameter	Injection	Store	Unit
No. of Bunches	60	60	
Bunch Spacing	213.874	213.148	ns
Ions/Bunch	6.0	6.0	10^9
Bunch Area	0.180	0.180	eV s/ N

From K.Gardner

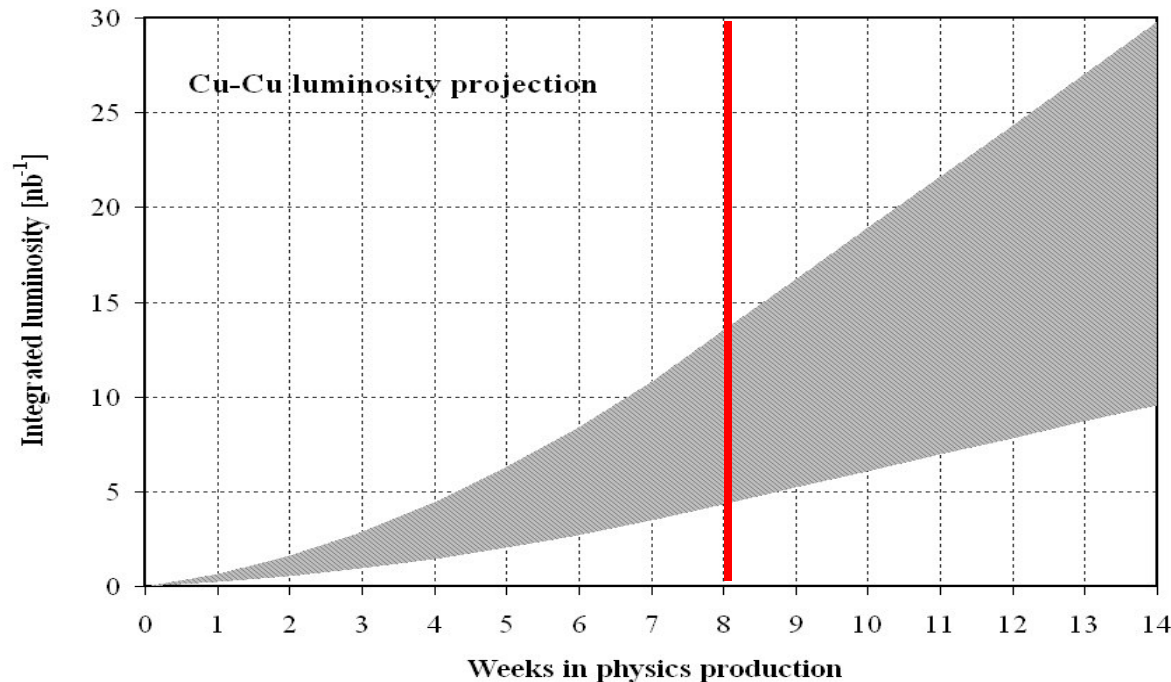


Cu Run-5 goals

- High energy Cu-Cu collisions 200 GeV/u
integrated delivered luminosity of 7 nb⁻¹
~ 8 weeks (discussion later)
- Low energy Cu-Cu collisions 62.4 GeV/u
~2 weeks
- Injection energy Cu-Cu collisions 22.5 GeV/u
~ 1 day



Luminosity development



Luminosity model

Minimum:

45 x 3×10^9 Cu ions

Maximum:

28 x 7×10^9 Cu ions

Lumi development over 8 week, then linear

Goal for Cu run 200GeV: Integrated delivered lumi of at least 7 nb⁻¹

At minimum (last year max operating performance) → ~10 weeks

At geometrical mean → 8 weeks

Re-evaluate run plans depending on initial machine performance, and feasibility of:

❑ 2 weeks at 62.4 GeV

❑ 1 day at 22.5 GeV



Luminosity limitations

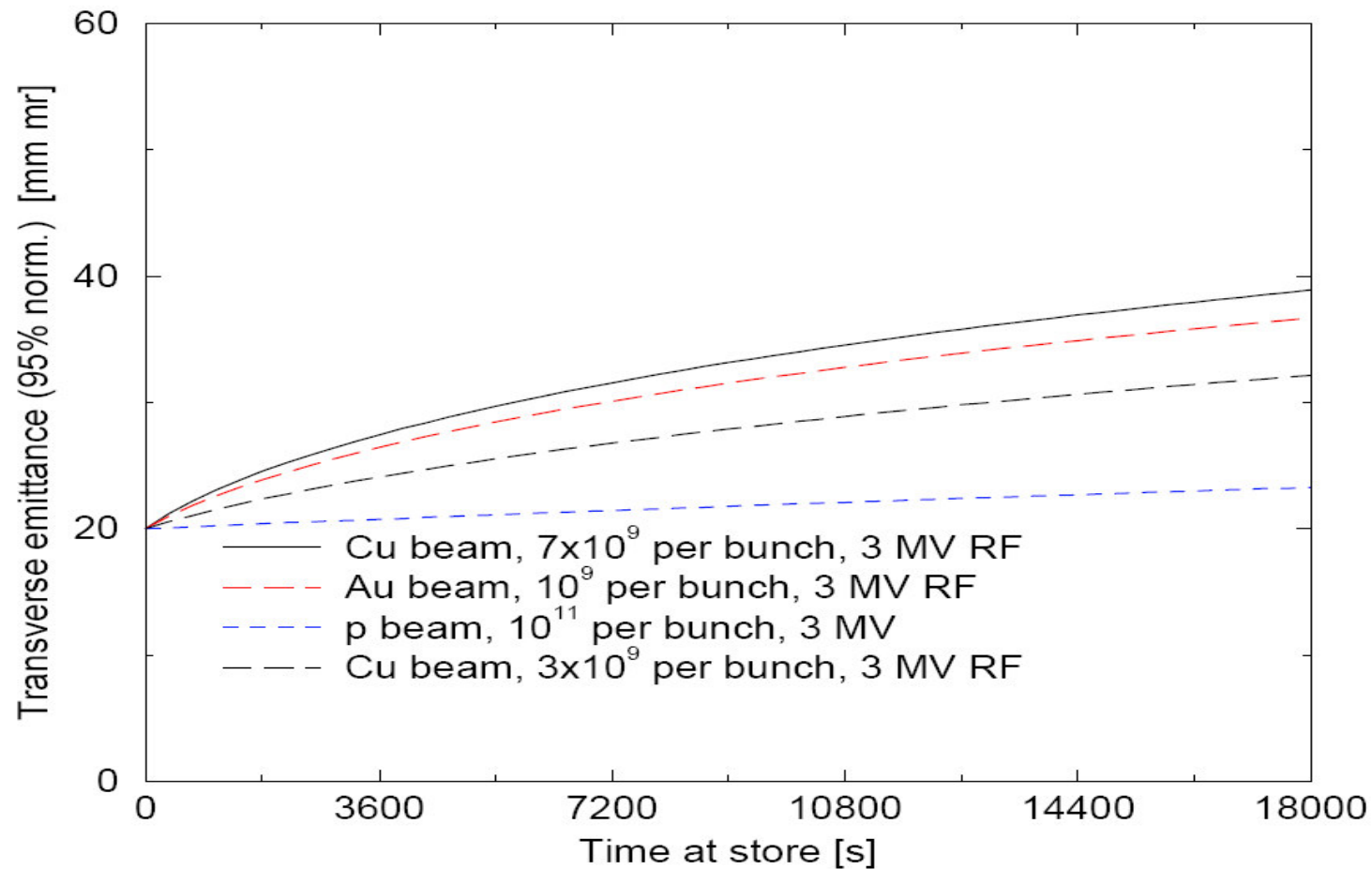
W. Fischer

- ❑ **Vacuum** (electron clouds, desorption from beam loss)
 - Vacuum instabilities
 - Experimental background
 - Use optimized bunch patterns
 - Installation of NEG coated pipes in warm regions: total ~250m in Run 5
- ❑ **Intrabeam scattering** (→ IBS model results – A. Fedotov)
 - Leads to luminosity lifetime of a few hours
 - Fast refills needed to increase average luminosity
 - Ultimately need cooling at full energy (stochastic, electron)
- ❑ **Beam-Beam**
 - New working point
 - Beam-beam diagnostics
- ❑ **Instabilities**
 - Potentially vulnerable near transition
 - Chromaticity control on ramp, octupoles for transition crossing (transverse)
Landau cavities (longitudinal)
 - Transition diagnostics (WCM, tomography)



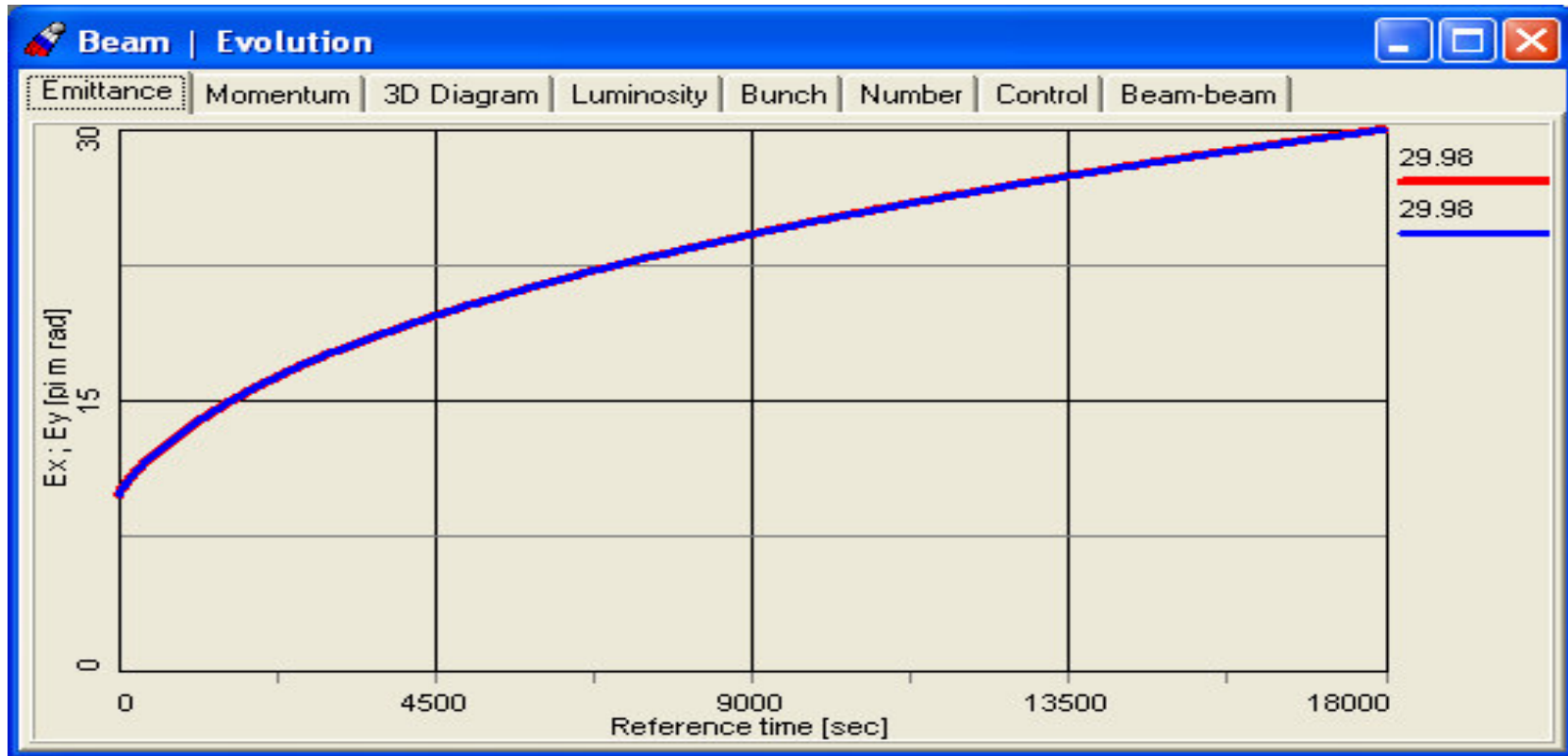
Emittance growth comparison

This if for emittance of 20π





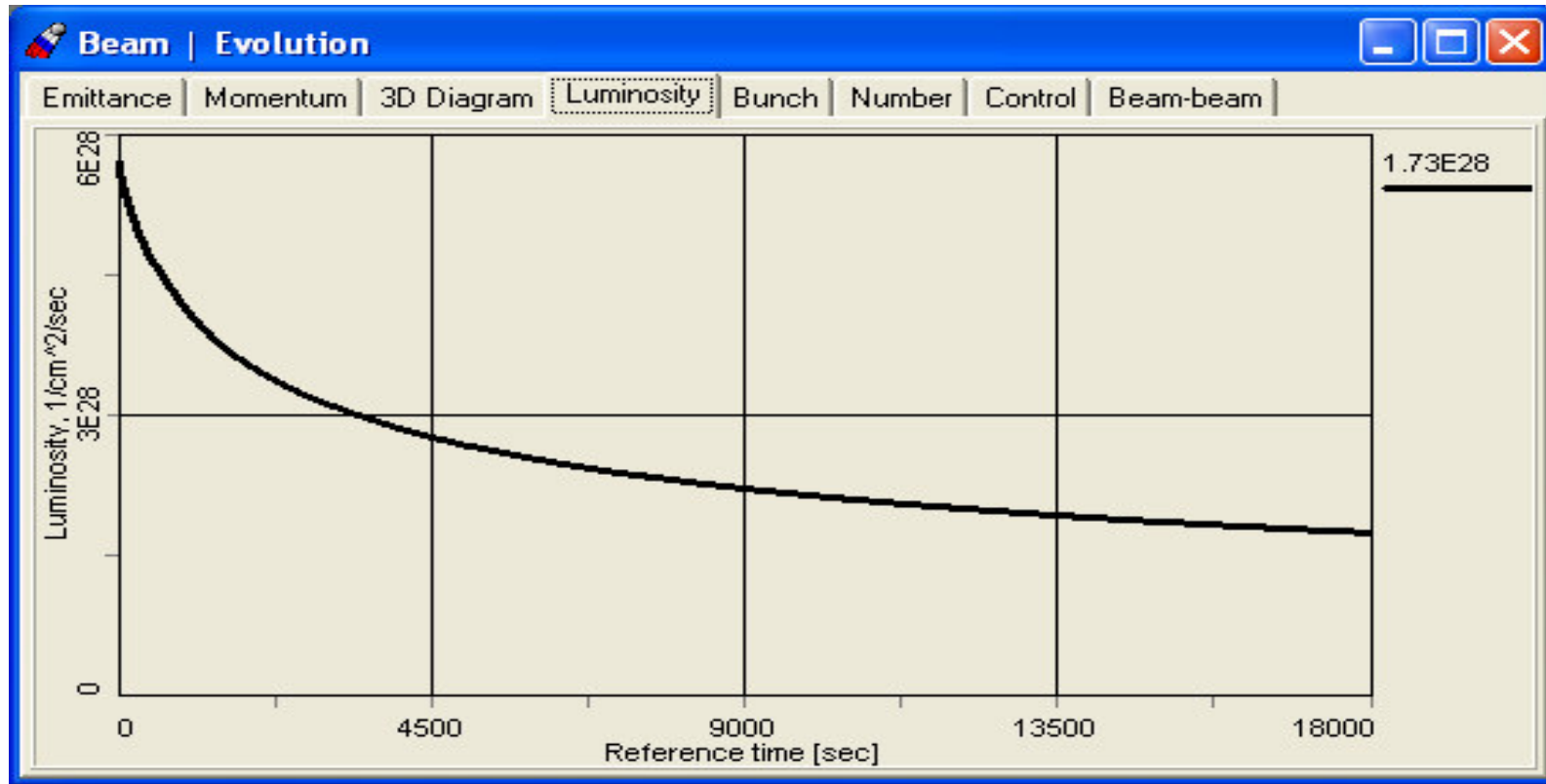
Low-emittance: 10π , high-intensity: $N=7 \cdot 10^9$



Factor of 3 increase in emittance in 5 hours



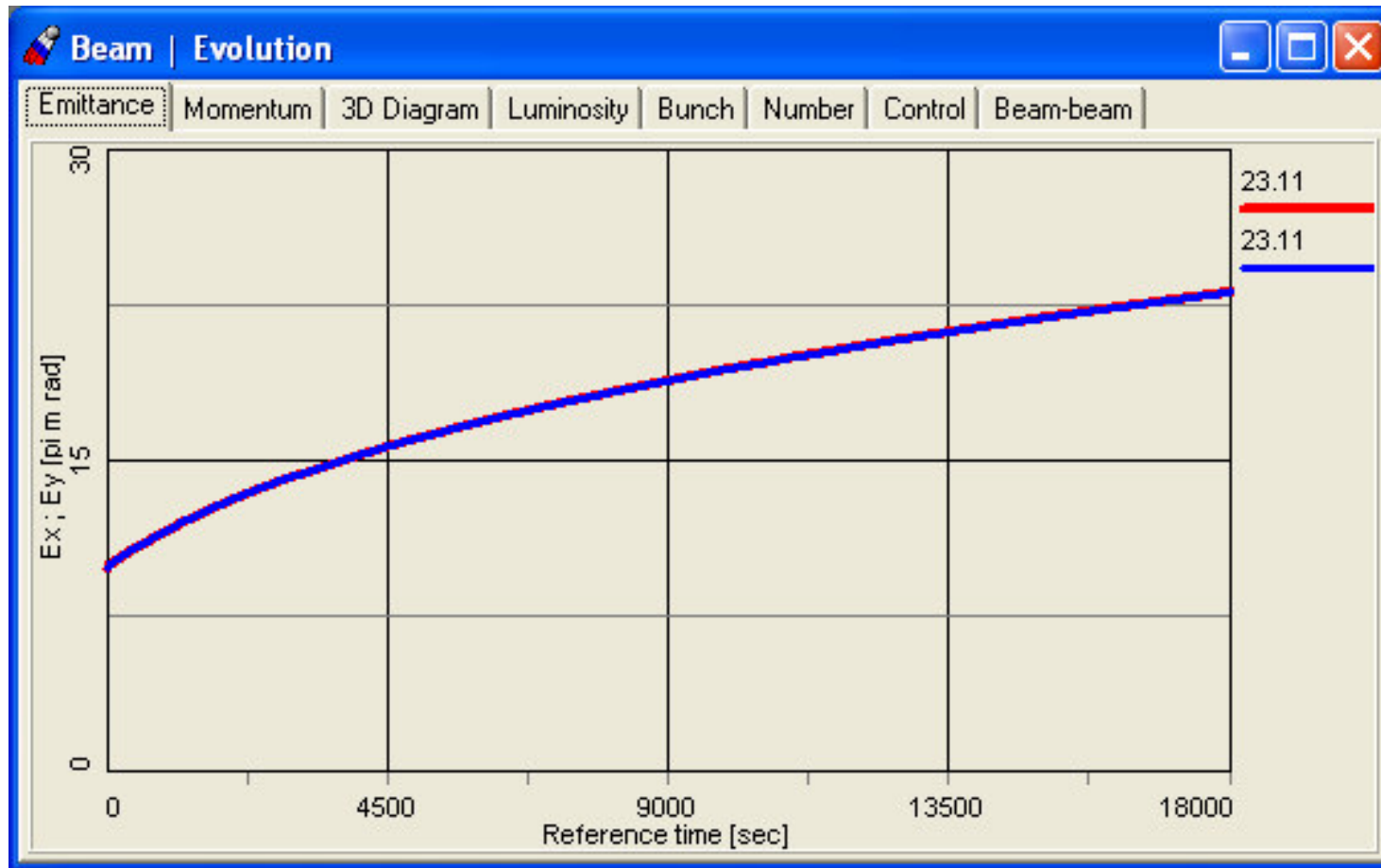
Low-emittance: 10π , high-intensity: $N=7 \times 10^9$



Luminosity is decreased by a factor 3.5



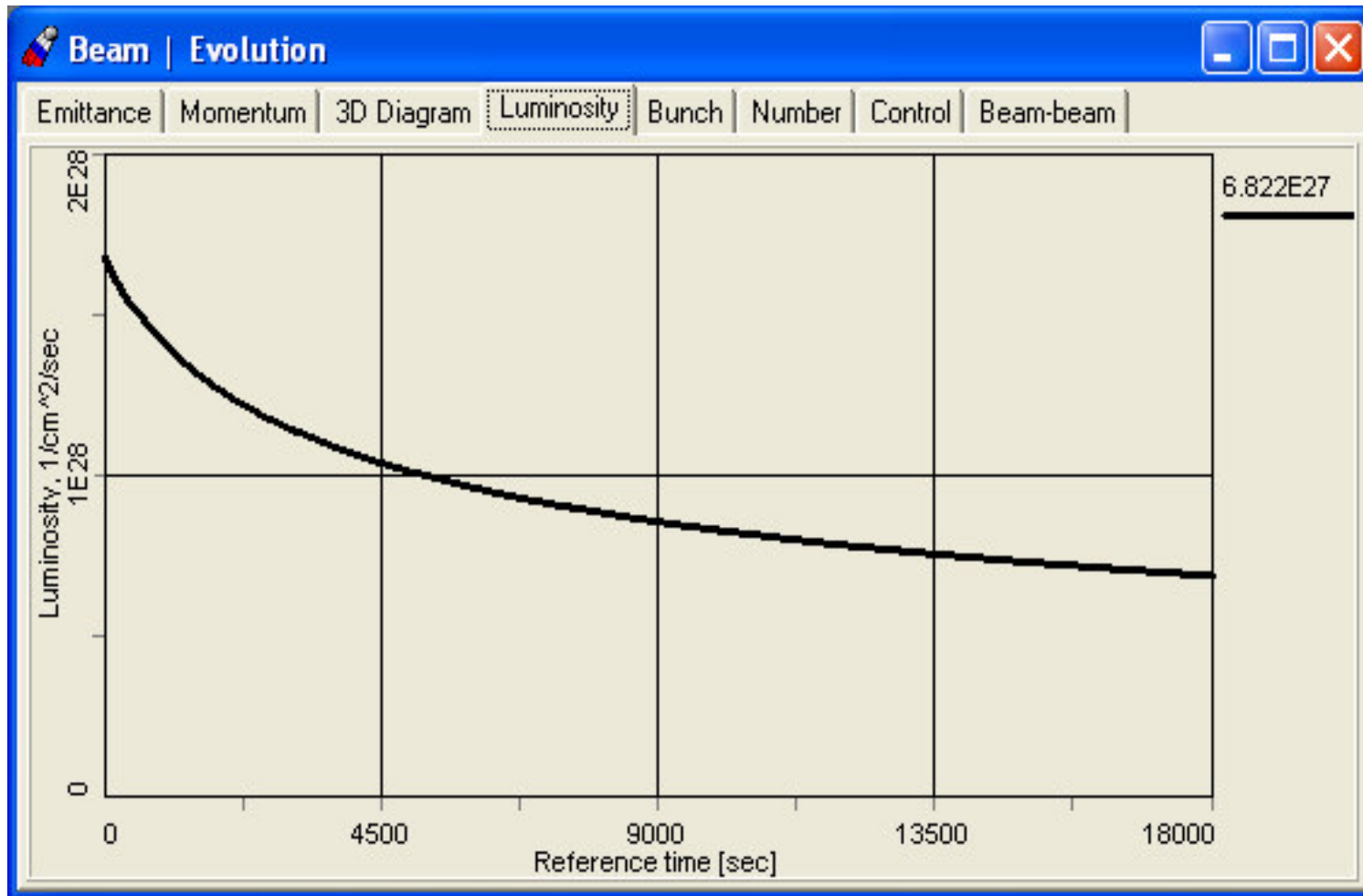
Low-emittance: 10π , low-intensity: $N=3 \times 10^9$



Emittance is increased by factor 2.3



Low-emittance: 10π , low-intensity: $N=3 \times 10^9$



Luminosity is decreased by a factor 2.5



Run-5 new timeline

Cool-down to 80 K

RHIC PAC

Dry Run 1

Beam Ex Workshop

Injector test with Cu

NSRL run end

Dry Run 2

Start cool-down 80K to 4K

Injectors Cu set-up

Dry Run 3

Beam in blue ring

Beam in both rings

Set-up Cu in RHIC

Ramp-up (+ collisions overnight)

Cu Physics 200 GeV/u (+ luminosity)

Cu set-up+ physics at 62.4 GeV/u

Cu set-up+ physics at injection

P-P set-up

Physics with P-P

September 7 (started) *on hold?re-cool?*

September 8-10

September 7-10

September 16-17

September 18-19 (week-end)

October 1

October 4-8 (possibly 11-15 ?)

November 7

November 1-15

November 8-12

November 15

November 22

November 22- December 6

December 7 - 20

~ 8 weeks (estimate)

~ 2 weeks (estimate)

~ 1 day (estimate)

3 weeks

~10 weeks (estimate)



Run-5 FY05 timeline

timeliny05 - Microsoft Internet Explorer provided by C-A Department

File Edit View Favorites Tools Help

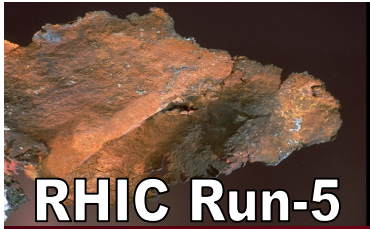
Back Forward Stop Home Search Favorites Media Print Mail

Address <http://www.agrichome.bnl.gov/SchedPhys/Montag/timeliny05.html> Go Links

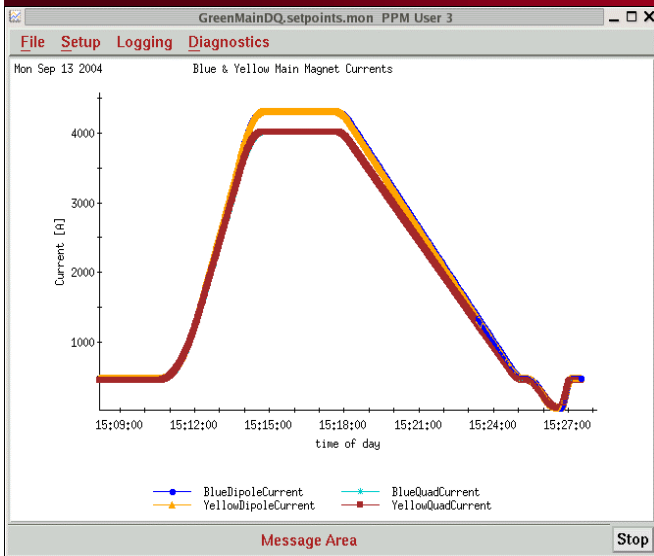
Week	Monday of the week	Description	Remarks
1	08-Nov-2004	2 weeks cooldown,	Cooldown starts Nov 7
2	15-Nov-2004	80K->4K	First BLUE beam Nov 15
3	22-Nov-2004	2 weeks RHIC start-up	Beam in both rings Nov 22
4	29-Nov-2004		
5	06-Dec-2004	2 weeks RHIC ramp-up	Collisions overnight,
6	13-Dec-2004		starting Dec 6
7	20-Dec-2004	7 weeks Cu-Cu Physics,	Starts Dec 20
8	27-Dec-2004	200 GeV/u	
9	29-Nov-2004		
10	03-Jan-2005		
11	10-Jan-2005		
12	17-Jan-2005		
13	24-Jan-2005		
14	31-Jan-2005	3 weeks p-p Set-up	
15	07-Feb-2005		
16	14-Feb-2005		
17	21-Feb-200	8 weeks p-p Physics	
18	28-Feb-2005		
19	07-Mar-2005		

SchedPhys
WEB Page

8 weeks PP physics
1 week warm-up



Dry Run 1



Cu-1 ramp (setpoints)

Plan and list of accomplished tasks on

<http://www.rhichome.bnl.gov/AP/RHIC2005>

Main goals Dry Run 1:

- ☐ Test of copper ramp Cu1
- ☐ Operations tools
- ☐ RHIC applications, old and new
- ☐ AtR applications and systems
- ☐ Operational sequences (reflect status of controls)

Dry Run 2 (october 4-8 or october 11-15)

As in Dry Run 1, BPM system integration

Dry Run 3 (november 8-12)

As in Dry Run 1,2 + hardware tests (where appropriate) overall system integration test, beam ready check-list



Improvements for Run-5

- ❑ Fixed **store length**
- ❑ **ZDC's** under CAD control
- ❑ **STAR magnet** control
- ❑ Low intensity pulse **interlock**
- ❑ **Decoupling** on ramp (development needed)
- ❑ **Orbit control at transition**, BBA (development needed)
- ❑ Correction **triplet roll 5 o'clock** (correction check needed)
- ❑ **Configuration control** WEB pages
- ❑ **FDAView** - databased fill parameter
- ❑ **QLI reduction** program
- ❑ Rework of all **corrector PS**
- ❑ 250 m total of **NEG pipes**



Improvements Run-5 con't

- ❑ Stochastic cooling system (development only)
- ❑ New vertical collimators
- ❑ Re-alignment
- ❑ BPM electronics into alcoves
- ❑ BPM new boards in IR8 IR6 IR10 IR4
- ❑ Improved high level, BPM and Orbit Managers, timing
- ❑ New BLM's at Q2 low beta and in AtR
- ❑ Upgraded/fixed IPM
- ❑ PLL application interface
- ❑ New WEB, operations file, backup file, database, Linux servers
- ❑ 10 new radiation hard FEC's



Open issues

The extra month allows more time for system and operations improvements:

- ❑ Ramp development, modification, maintenance
- ❑ Faster down-ramps
- ❑ **Injection improvements**: faster BPM data acquisition and automatic AGS field correction
- ❑ (some of) **The List** (injectors)
- ❑ **AtR** automatic orbit correction
- ❑ **Sequencer** errors handling



Beam Experiments

Even wearing now the hat of Run Coordinator...😊

I think that regular scheduling of beam ex is important

Schedule very early studies that are more relevant to operations, i.e.

- ❑ ramp to 0.85-0.9 m (if that cannot be tried out during ramp-up)
- ❑ diagnostics improvements/ techniques (ex: Schottky)
- ❑ Development of 250 GeV PP ?
- ❑ Collaborative studies